

SCIENCE

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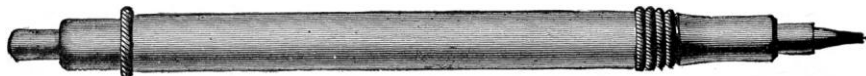
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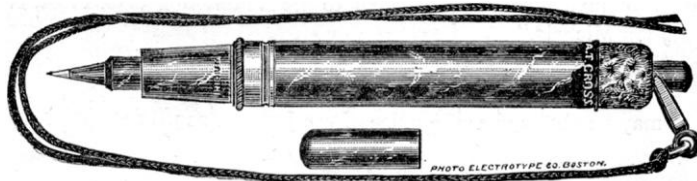
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A WEEKLY JOURNAL OF SCIENTIFIC PROGRESS.

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All communications should be addressed to the Editor—box 3838, P. O., New York—with name and address of writer, not necessarily for publication without consent.

Scientific papers and correspondence intended for publication should be written *legibly* on one side only of the paper. Articles thus received will be returned when found unsuitable for the Journal.

Those engaged in Scientific Research are invited to make this Journal the medium of recording their work, and facilities will be extended to those desirous of publishing original communications possessing merit.

Proceedings of Scientific Societies will be recorded, but the abstracts furnished must be signed by the Secretaries.

Both questions and answers in "Notes and Queries" should be made as brief as possible; an answer appearing to demand an elaborate reply may be written in the form of an article.

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JOHN MICHELS, Editor.

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MICROSCOPES AND THEIR OBJECTIVES.

WE are told by one maker of microscopes that he has orders in advance which will prevent his undertaking new work for at least four months from the present time. Supposing his statement to be true, and we heartily trust it is, it would appear to show that the number of those undertaking microscopical investigations is largely on the increase, and as the probabilities are that many of those now investing their money in microscopes and objectives, are doing so with little experience to guide them in their selection, it may be useful at this moment to take a review of the microscope market.

The purchase of the microscope stand and the objectives to use with it will be considered separately. They are usually purchased together, but there is no reason for doing so, and we would like to see each handled by a distinct branch of trade. To make a good microscope stand needs only the skill of a good worker in brass, under suitable direction. On the other hand, the manufacture of objectives, and the other optical parts of a microscope, requires the skilled labor of an optician.

In regard to the microscope stand, we would state that many improvements have been recently made, so that to avoid being saddled with one which may be considered obsolete, it would be as well to go directly to one who manufactures his own stands, and direct him to make one to order; by so doing, the additional advantage will be secured of obtaining an instrument specially suited for particular work—a very important point.

The temptation is great to name one or two microscope stands which, in our opinion, are perfect in

workmanship, designed on the best model and, withal, quite moderate in price; but to do so would court misinterpretation of our motives; so we may state that such firms as Bausch & Lomb, Beck, Bullock, Grunow, Schrauer, Slidel, Zentmayer, are all reliable American manufacturers, and that most of these firms now produce such an instrument as we would advise, at a cost of about 40 to 50 dollars for a Monocular stand, not including accessory apparatus or objectives. We have just seen an instrument, for the latter price, having perfection of workmanship and the latest improvements.

In regard to microscope objectives, the greatest caution should be employed by the inexperienced at this moment, for after twenty-five years experience in purchasing objectives, the present price-lists of opticians appear to us a perfect chaos of quotations.

In the first place, the objection has been raised by purchasers that object glasses of a certain focal length and stated aperture, vary in their linear magnifying power, among different makers, so that a quarter-inch which, for instance, should give 200 diameters with an A eye-piece, is found to be a 4-10, allowing only 120 diameters if purchased of another maker, or perhaps it will give 225 diameters similar to a 1-5th, when obtained from a third manufacturer—even when the conditions are alike. This, no doubt, originated in one of the tricks of the trade. A makes a 1-4th which, in resolving power, equals the 1-6th of B; in consequence, A claims at once a superiority of workmanship, and perhaps secures a reputation for objectives, when, if the truth was known, the 1-4th was in fact a 1-6th.

It must be remembered also that all objectives vary in quality even from the same maker, and that one may be given to an inexperienced person which is very far from the supposed standard of excellence; with some makers not more than one in twelve would be accepted by an expert.

Lastly, there appears to be a feeling that considerable improvements are imminent in the manufacture of objectives, rendering those of yesterday commercially valueless. If we may judge by a price list just forwarded, a panic appears to have commenced among those holding objectives made as recently as four years ago. By a circular, we are informed that the objectives of one of the most esteemed makers are now offered at prices 50 per cent. lower than those charged by the maker. "These lenses are of the *best quality* and *perfectly new*," "simply to close out our stock of these objectives." This offer is made by an optician in the same city with the original maker. Objectives which cost \$150 can be had for \$75, and others as follows: \$110 for \$55, \$50 for \$30. \$40 for

\$20, and one very noted objective for which the maker asks \$60 is offered for \$27.20.

We also notice the production of a 1-10th objective of 180° aperture, by a maker of reputation, which is sold at \$25. A subscriber recently called at our office and stated that a 1-6th by the same maker, also sold at \$25, divided the 19th band of Nobert's plate.

We mention these facts to show the variations in the present cost of microscope objectives, which must be perplexing to inexperienced purchasers. The regular price of a first-class 1-10th, of 180°, is about \$85, and it would be interesting to compare the \$25 article and note results; and it would also be useful to note how the cheaper glasses perform their work, as compared one with another.

As any expression of opinion on the merits of these objectives would be useless, without they were personally tested by us, we refrain from offering any advice on the subject. Microscope objectives are not struck in a die like medals, but are the result of manual operation, in which the individuality of the artist may be recognized and developed. In art the relative merits of the master are appreciated by the connoisseur, and a standard of value established; the same rule applies to optical instruments when perfection of work is aimed at. When Professor Asaph Hall discovered the satellites of Mars, it was necessary to have a telescope which would show an object six miles in diameter at a distance of 35,000,000 miles; when called upon to perform this feat, Clark's 32-inch objective responded in a manner which enabled Professor Hall to make one of the most important of recent astronomical discoveries. To appreciate this performance of the Washington telescope, we may state that it was equivalent to a person stationed at New York seeing an object at Boston which was two inches in diameter.

Such is the class of work we desire to find in microscopic objectives; probably there are only one or two men in this country able to produce it; but it is difficult to speculate as to what the future may bring forth.

WALKER PRIZES IN NATURAL HISTORY.

The Boston Society of Natural History offers a first prize of \$60 to \$100, and a second of \$50, for the best memoirs, in English, on the following subjects: For 1881, The Evidences of the Extension of Tertiary Deposits seaward along the coast of Massachusetts; for 1882, The Occurrence, Microscopic Structure, and use of North American Fibre-plants (treating especially of the fibres employed by the native races); for 1883, Original Unpublished Investigations respecting the Life-History of any Animal. Prizes will not be awarded unless the papers are deemed of adequate merit.

THE ODONTORNITHES.

EXTINCT TOOTHED BIRDS OF NORTH AMERICA.

We merely desire in this place to acknowledge the receipt of the monograph, on the *Odontornithes*, an extinct order of toothed birds of North America, prepared by Professor O. C. Marsh, and published by order of the United States Government.

A review of this work is now in course of preparation by one well able to present Professor Marsh's discoveries in all their integrity, and we propose to publish the same with illustrations, which will convey to the readers of "SCIENCE" a fair estimate of the value of this work, which is considered by many to be one of the most important contributions to science, issued by the National Government at Washington.

Reserving our review of Professor Marsh's monograph for a future occasion, we now offer his own explanation regarding the work, as conveyed in a few introductory remarks:

"The remains of birds are among the rarest of fossils, and very few have been discovered except in the more recent formation. According to present evidence, the oldest known birds were imbedded in the Jurassic deposits of Europe, which have yielded three individuals belonging to the genus *Archaeopteryx*, so well preserved that the more important characters can be determined. The only other remains of birds found in the Mesozoic of the Old World are a few specimens from the Cretaceous of England, which are too fragmentary to throw much light on the extinct forms they represent.

"The earliest traces of birds hitherto found in the strata of this country are from the Cretaceous, although we may confidently predict their discovery in the Jurassic beds, if not at a still lower horizon. There is at present no evidence whatever that any of the three-toed impressions in the Triassic, described as the foot prints of birds, were made by birds; and the proof now seems conclusive that nearly all of them are the tracks of Dinosaurian reptiles, bones of which occur in the same deposits.

"In the Cretaceous beds of the Atlantic coast, and especially in the green-sand region of New Jersey, various remains of birds have been found and described by the writer. These fossils, although often in excellent preservation, occur mainly as isolated bones, and hence their near affinities have not as yet been determined with certainty.

"Along the western slope of the Rocky Mountains, and especially on the adjoining plains in Kansas and Colorado, there is a series of Cretaceous strata remarkably rich in vertebrate fossils. The deposits are all marine, and, away from the mountains, they lie nearly horizontal. They have suffered much from erosion, and are still wasting away, especially along the river valleys. These beds consist mainly of a fine yellow chalk and calcareous shale, both admirably adapted to preserve delicate specimens, and here have been found the extinct birds which form the subject of the present memoir.

"The geological horizon of the known *Odontornithes* is in the Middle Cretaceous and corresponds to the strata named by the writer the "Pteranodon beds." The latter are included in sub-division number three, in Meek and Hayden's section. The accompanying fossils are Mosasauroid reptiles, which are very abundant; Plesiosaurs allied to *Pliosaurus*; Pterodactyles of the genus *Pteranodon*; and many fishes. With these occur Rudistes, and occasionally Ammonites, Belemnites, and various other Cretaceous invertebrates.

"The first bird fossil discovered in this region was the lower end of the tibia of *Hesperornis*, found by the writer in December, 1870, near the Smoky Hill River in Western Kansas. Specimens belonging to another genus of the *Odontornithes* were discovered on the same expedition. The extreme cold, and danger from hostile Indians, rendered a careful exploration at that time impossible.

"In June of the following year, the writer again visited the same region, with a larger party, and a stronger escort of United States troops, and was rewarded by the discovery of the skeleton which forms the type of *Hesperornis regalis*, Marsh. Various other remains of *Odontornithes* were secured, and have since been described by the writer. Although the fossils obtained during two months of explorations were important, the results of this trip did not equal our expectations, owing in part to the extreme heat (110° to 120° Fahrenheit, in the shade) which, causing sun stroke and fever, weakened and discouraged guides and explorers alike.

"A considerable part of these Cretaceous deposits still remain unexplored, and in the Autumn of 1872, a third expedition through this territory was undertaken by the writer with a small party. Additional specimens of much interest were secured, including the type of the genus *Apatornis*, and one nearly complete skeleton of *Hesperornis*—an ample reward for the hardship and danger we incurred.

"The specimens thus secured by these various expeditions have since been supplemented by important additions, collected in the same general region by different parties equipped and sent out by the writer, who no longer could give his personal supervision to work in that field. The fossil birds procured in this region, since 1870, by these different expeditions, include remains of more than one hundred different individuals of the *Odontornithes*. These are all in the Museum of Yale College, and form the material on which the present volume is based.

"A study of this extensive series of bird remains brings to light the existence, in this class, of two widely-separated types, which lived together during the Cretaceous period, in the same region, and yet differed more from each other than do any two recent birds. Both of these types possessed teeth, a character hitherto unknown in the class of birds, and hence they have been placed by the writer in a separate sub-class, the *Odontornithes*. One of these groups includes very large swimming birds, without wings and with the teeth in grooves (*Odontotæ*), and is represented by the genus *Hesperornis*. The other contains small birds, endowed with great powers of flight, and having teeth in sockets (*Odontotormæ*), and biconcave vertebræ; a type best illustrated by the genus *Ichthyornis*. Other characters, scarcely less important, appear in each group, and we have thus a vivid picture of two primitive forms of bird structure, as unexpected as they are suggestive. A comparison of these two forms with each other, and with some recent birds, promises to clear away many difficulties in the genealogy of this class, now a closed type; and hence they are well worthy of the detailed description and full illustration here devoted to them.

"The fossil birds now known from the Cretaceous deposits of this country are included in nine genera and twenty species. These have all been described by the writer, and are represented, at present, by the remains of about one hundred and fifty different individuals. This is evidence of a rich and varied avian fauna in America during Mesozoic time, and likewise indicates what we may expect from future discoveries.

"The present volume is the first of a series of Monographs designed to make known to science the extinct vertebrate life of North America. In the investigation of this subject, the writer has spent the past ten years, much of it in the field, collecting, with no little hardship and danger, the material for study, and the rest in working out the characters and affinities of the ancient forms of life thus discovered.

"During this decade, the field work extending from the Missouri River to the Pacific Coast has so predominated as the subject unfolded, that a plan of gradual publication became a necessity. The more important discoveries were briefly announced soon after they were made, but

only where the specimens on which they were based admitted of accurate determination. The principal characters of the new groups were next worked out systematically, and published with figures of the more important parts. When the investigation of a group is completed, the results, with full descriptions and illustrations, will be brought together in a monograph. This system has been carried out with the *Odontornithes*, and will be continued with the other groups. The investigation of several of these is now nearly completed, and the result will soon be ready for publication.

"The material is abundant for a series of monographs on the marvelous extinct vertebrates of this country, and the results already attained are full of promise for the future. A somewhat careful estimate makes the number of new species of extinct vertebrates, collected since 1868, and now in the Yale College Museum, about 1000. Nearly 300 of these have already been described by the writer, and some have been noticed or described by other authors, but at least one-half remain to be investigated.

"Among the new groups brought to light by these researches, and already made known by descriptions of their principal characters, are the following, which will be fully described in subsequent volumes of the present series.

"The first Pterodactyles or flying reptiles discovered in this country, were found by the writer in the same geological horizon with the *Odontornithes* described in the present memoir. These were of enormous size, some having a spread of wings of nearly twenty-five feet; but they were especially remarkable on account of having no teeth, and hence resembling recent birds. They form a new order, *Pteranodontia*, from the type genus *Pteranodon*. Of this group, remains of more than six hundred individuals are now in the Yale College Museum—ample material to illustrate every important point in their osteology.

"With these fossils were found also great numbers of Mosasauroid reptiles, a group which, although rare in Europe, attained an enormous development in this country, both in numbers and variety of forms. Remains of more than fourteen hundred individuals belonging to this order were secured during the explorations of the last ten years, and are now in the Museum of Yale College.

"The most interesting discoveries made in the Jurassic formation were the gigantic reptiles belonging to the new sub-order *Sauropoda*, including by far the largest land animals yet discovered. Another remarkable group of large reptiles found in the same formation were the *Stegosauria*. Other Dinosaurs from the same horizon, the 'Atlantosaurus beds,' show that this was the dominant form of vertebrate life in that age, and many hundred specimens of these reptiles are now in the Yale Museum. In a lower horizon of the same formation, the 'Sauranodon beds,' were found the remains of a peculiar new group of reptiles, the *Sauranodontia*, allied to *Ichthyosaurus*, but without teeth.

"In the Eocene deposits of the Rocky Mountains, the writer discovered a new order of huge mammals, the *Dinocerata*. Remains of several hundred individuals were secured, and a monograph on the group will follow the present memoir. In the same formation were found the remains of another new order of mammals, the *Tillodontia*, in many respects the most remarkable of any yet discovered. In the same Eocene deposits were secured the first remains of the fossil *Primates* known from North America as well as the first *Cheiroptera* and *Marsupialia*. Abundant material also was found in the same region to illustrate the genealogy of the Horse, and a memoir on this subject is in course of preparation.

CHOLESTEN.—This compound, $C_{26}H_{42}$, is a white amorphous powder, almost insoluble in alcohol, but soluble in ether. It resembles *c.* cholesterol in its physical and chemical properties.—W. E. Walitzky.

THE UNITY OF NATURE.

BY THE DUKE OF ARGYLL.

VI.

ON THE MORAL CHARACTER OF MAN, CONSIDERED IN THE LIGHT OF THE UNITY OF NATURE.

The consciousness of unworthiness in respect to moral character is a fact as fundamental, and as universal in the human mind as the consciousness of limitation in respect to intellectual power. Both of them may exist in a form so rudimentary as to be hardly recognizable. The limits of our intelligence may be felt only in a dim sense of unsatisfied curiosity. The faultiness of our character may be recognized only in the vaguest emotions of occasional self-reproach. But as the knowledge of mankind extends, and as the cultivation of their moral faculties improves, both these great elements of consciousness become more and more prominent, and occupy a larger and larger place in the horizon of their thoughts. It is always the men who know most who feel most how limited their knowledge is. And so likewise it is always the loftiest spirits who are most conscious of the infirmities which beset them.

But although these two great facts in human consciousness are parallel facts, there is a profound difference between them; and to the nature and bearing of this difference very careful attention must be paid.

We have seen in regard to all living things what the relation is between the physical powers which they possess and the ability which they have to use them. It is a relation of close and perfect correspondence. Everything requisite to be done for the unfolding and upholding of their life they have impulses universally disposing them to do, and faculties fully enabling them to accomplish. We have seen that in the case of some animals this correspondence is already perfect from the infancy of the creature, and that even in the case of those which are born comparatively helpless, there is always given to them just so much of impulse and of power as is requisite for the attainment of their own maturity. It may be nothing more than the mere impulse and power of opening the mouth for food, as in the case of the chicks of many birds; or it may be the much more active impulse and the much more complicated power by which the young mammalia seek and secure their nourishment; or it may be such wonderful special instincts as that by which the newly hatched Cuckoo, although blind and otherwise helpless, is yet enabled to expel its rivals from the nest, and thus secure that undivided supply of food without which it could not survive. But whatever the impulse or the power may be, it is always just enough for the work which is to be done. We have seen, too, that the amount of prevision which is involved in those instinctive dispositions and actions of animals is often greatest in those which are low in the scale of life, so that the results for which they work, and which they do actually attain, must be completely out of sight to them. In the wonderful metamorphoses of insect life, the imperfect creature is guided with certainty to the choice and enjoyment of the conditions which are necessary to its own development; and when the time comes it selects the position, and constructs the cell, in which its mysterious transformations are accomplished.

All this is in conformity with an absolute and universal law in virtue of which there is established a perfect unity between these three things:—first, the physical powers and structure of all living creatures; secondly, those dispositions and instinctive appetites which are seated in that structure to impel and guide its powers; and thirdly, the external conditions in which the creature's life is passed, and in which its faculties find an appropriate field of exercise.

If Man has any place in the unity of Nature, this law must prevail with him. There must be the same corres-

pondence between his powers and the instincts which incite and direct him in their use. Accordingly, it is in this law that we find the explanation and the meaning of his sense of ignorance. For without a sense of ignorance there could be no desire of knowledge, and without his desire of knowledge Man would not be Man. His whole place in Nature depends upon it. His curiosity, and his wonder, and his admiration, and his awe—these are all but the adjuncts and subsidiary allies of that supreme affection which incites him to inquire and know. Nor is this desire capable of being resolved into his tendency to seek for an increased command over the comforts and conveniences of life. It is wholly independent of that kind of value which consists in the physical utility of things. The application of knowledge comes after the acquisition of it, and is not the only, or even the most powerful, inducement to its pursuit. The real incitement is an innate appetite of the mind—conscious in various degrees of the mystery, and of the beauty, and of the majesty of the system in which it lives and moves; conscious, too, that its own relations to that system are but dimly seen and very imperfectly understood. In a former chapter we have seen that this appetite of knowledge is never satisfied, even by the highest and most successful exertion of those faculties which are, nevertheless, our only instruments of research. We have seen, too, what is the meaning and significance of that great Reserve of Power which must exist within us, seeing that it remains unexhausted and inexhaustible by the proudest successes of discovery. In this sense it is literally true that the eye is not satisfied with seeing, nor the ear filled with hearing. Every new advance has its new horizon. Every answered question brings into view another question unanswered, and perhaps unanswerable, lying close behind it. And so we come to see that this sense of ignorance is not only part of our nature, but one of its highest parts—necessary to its development, and indicative of those unknown and indefinite prospects of attainment which are at once the glory and the burden of humanity.

It is impossible to mistake, then, the place which is occupied among the unities of Nature by that sense of ignorance which is universal among men. It belongs to the number of those primary mental conditions which impel all living things to do that which it is their special work to do and in the doing of which the highest law of their being is fulfilled. In the case of the lower animals, this law, as to the part they have to play and the ends they have to serve in the economy of the world, is simple, definite, and always perfectly attained. No advance is with them possible, no capacity of improvement, no dormant or undeveloped powers leading up to wider and wider spheres of action. With Man, on the contrary, the law of his being is a law which demands progress, which endows him with faculties enabling him to make it, and fills him with aspirations which cause him to desire it. Among the lowest savages there is some curiosity and some sense of wonder, else even the rude inventions they have achieved would never have been made, and their degraded superstitions would not have kept their hold. Man's sense of ignorance is the greatest of his gifts, for it is the secret of his wish to know. The whole structure and the whole furniture of his mind is adapted to this condition. The highest law of his being is to advance in wisdom and knowledge; and his sense of the presence and of the power of things which he can only partially understand is an abiding witness of this law, and an abiding incentive to its fulfillment.

In all these aspects there is an absolute contrast between our sense of limitation in respect to intellectual power (or knowledge) and our sense of unworthiness in respect to moral character. It is not of ignorance, but of knowledge, that we are conscious here,—even the knowledge of the distinction between good and evil, and of that special sense which in our nature is associated with it, namely, the sense of moral obligation. Now it is a uni-

versal fact of consciousness as regards ourselves, and of observation in regard to others, that, knowing evil to be evil, men are nevertheless prone to do it, and that having this sense of moral obligation, they are nevertheless prone to disobey it. This fact is entirely independent of the particular standard by which men in different stages of society have judged certain things to be good and other things to be evil. It is entirely independent of the infinite variety of rules according to which they recognize the doing of particular acts, and the abstention from other acts, to be obligatory upon them. Under every variety of circumstance in regard to these rules, under every diversity of custom, of law, or of religion by which they are established, the general fact remains the same—that what men themselves recognize as duty they continually disobey, and what according to their own standard they acknowledge to be wrong they continually do.

There is unquestionably much difficulty in finding any place for this fact among the unities of Nature. It falls, therefore, in the way of this inquiry to investigate how this difficulty arises, and wherein it consists.

And here we at once encounter those old fundamental questions on the nature, the origin, and the authority of the Moral Sense which have exercised the human mind for more than two thousand years; and on which an eminent writer of our own time has said that no sensible progress has been made. This result may well suggest that the direction which inquiry has taken is a direction in which progress is impossible. If men will try to analyze something which is incapable of analysis, a perpetual consciousness of abortive effort will be their only and their inevitable reward.

For just as in the physical world there are bodies or substances which are (to us) elementary, so in the spiritual world there are perceptions, feelings, or emotions, which are equally elementary—that is to say, which resist all attempts to resolve them into a combination of other and similar affections of the mind. And of this kind is the idea, or the conception, or the sentiment of obligation. That which we mean when we say, "I ought," is a meaning which is incapable of reduction. It is a meaning which enters as an element into many other conceptions, and into the import of many other forms of expression, but it is itself uncompounded. All attempts to explain it do one or other of these two things—either they assume and include the idea of obligation in the very circumlocutions by which they profess to explain its origin; or else they build up a structure which, when completed, remains as destitute of the idea of obligation as the separate materials of which it is composed. In the one case, they first put in the gold, and then they think that by some alchemy they have made it; in the other case, they do not indeed first put in the gold, but neither in the end do they ever get it. No combinations of other things will give the idea of obligation, unless with and among these things there is some concealed or unconscious admission of itself. But in this, as in other cases with which we have already dealt, the ambiguities of language afford an easy means or an abundant source of self-deception. One common phrase is enough to serve the purpose—the "association of ideas." Under this vague and indefinite form of words all mental operations and all mental affections may be classed. Consequently those which are elementary may be included, without being expressly named. This is one way of putting in the gold and then of pretending to find it as a result. Take one of the simplest cases in which the idea of obligation arises, even in the rudest minds—namely, the case of gratitude to those who have done us good. Beyond all question, this simple form of the sense of obligation is one which involves the association of many ideas. It involves the idea of Self as a moral agent and the recipient of good. It involves the idea of other human beings as likewise moral agents, and as related to us

by a common nature, as well as, perhaps, by still more special ties. It involves the idea of things good for them, and of our having power to confer these things upon them. All these ideas are "associated" in the sense of gratitude towards those who have conferred upon us any kind of favor. But the mere word "association" throws no light whatever upon the nature of the connection. "Association" means nothing but grouping or contiguity of any kind. It may be the grouping of mere accident—the associations of things which happen to lie together, but which have no other likeness, relation, or connection. But this, obviously, is not the kind of association which connects together the different ideas which are involved in the conception of gratitude to those who have done us good. What then is the associating tie? What is the link which binds them together, and constitutes the particular kind or principle of association? It is the sense of obligation. The associating or grouping power lies in this sense. It is the centre round which the other perceptions aggregate. It is the seat of that force which holds them together, which keeps them in a definite and fixed relation, and gives its mental character to the combination as a whole.

If we examine closely the language of those who have attempted to analyze the Moral Sense, or, in other words, the sense of obligation, we shall always detect the same fallacy—namely, the use of words so vague that under cover of them the idea of obligation is assumed as the explanation of itself. Sometimes this fallacy is so transparent in the very forms of expression which are used, that we wonder how men of even ordinary intelligence, far more men of the highest intellectual power, can have failed to see and feel the confusion of their thoughts. Thus, for example, we find Mr. Grote expressing himself as follows: "This idea of the judgment of others upon our conduct and feeling as agents, or the idea of our own judgment as spectators in concurrence with others upon our own conduct as agents, is the main basis of what is properly called Ethical sentiment."¹ In this passage the word "judgment" can only mean moral judgment, which is an exercise of the Moral Sense; and this exercise is gravely represented as the "basis" of itself.

Two things, however, ought to be carefully considered and remembered in respect to this elementary character of the Moral Sense. The first is, that we must clearly define to ourselves what the idea is of which, and of which alone, we can affirm that it is elementary; and secondly, that we must define ourselves as clearly, if it be possible to do so, in what sense it is that any faculty whatever of the mind can really be contemplated as separable from, or as uncombined with, others.

As regards the first of these two things to be defined, namely, the idea which we affirm to be simple or elementary, it must be clearly understood that this elementary character, this incapability of being reduced by analysis, belongs to the bare sense or feeling of obligation, and not at all, or not generally, to the processes of thought by which that feeling may be guided in its exercise. The distinction is immense and obvious. The sense of rightness and of wrongness is one thing; the way in which we come to attach the idea of right or wrong to the doing of certain acts, or to the abstention from certain other acts, is another and a very different thing. This is a distinction which applies equally to many other simple or elementary affections of the mind. The liking or disliking of certain tastes or affections of the palate is universal and elementary. But the particular tastes which are the objects of liking or of aversion are for the most part determined by habits and education. There may be tastes which all men are so constituted as necessarily to feel disgusting; and in like manner there may be certain acts which all men everywhere must feel to be con-

¹ "Fragments on Ethical Subjects," pp. 9, 10.

trary to their sense of obligation. Indeed we shall see good reason to believe that this not only may be so, but must be so. But this is a separate subject of inquiry. The distinction in principle is manifest between the sense itself and the laws by which its particular applications are determined.

The second of the two things to be defined—namely, the sense in which any faculty whatever of the mind can really be regarded singly, or as uncombined with others—is a matter so important that we must stop to consider it with greater care.

The analogy is not complete, but only partial, between the analysis of Mind and the analysis of Matter. In the analysis of Matter we reach elements which can be wholly separated from each other, so that each of them can exist and can be handled by itself. In the analysis of Mind we are dealing with one organic whole; and the operation by which we break it up into separate faculties or powers is an operation purely ideal, since there is not one of these faculties which can exist alone, or which can exert its special functions without the help of others. When we speak, therefore, of a Moral Sense or of Conscience, we do not speak of it as a separate entity any more than when we speak of Reason or of Imagination. Strictly speaking, no faculty of the mind is elementary in the same sense in which the elements of Matter are (supposed to be) absolutely simple or uncombined. Perhaps there is no faculty of the mind which presents itself so distinctly and is so easily separable from others as the faculty of Memory. And yet Memory cannot always reproduce its treasures without an effort of the Will, nor, sometimes, without many artificial expedients of Reason to help it in retracing the old familiar lines. Neither is there any faculty more absolutely necessary than Memory to the working of every other. Without Memory there could not be any Reason, nor any Reflection nor any Conscience. In this respect all the higher faculties of the human mind are much more inseparably blended and united in their operation than those lower faculties which are connected with bodily sensation. These lower faculties are indeed also parts of one whole, are connected with a common centre, and can all be paralyzed when that centre is affected. But in their ordinary activities their spheres of action seem widely different, and each of them can be, and often is, seen in apparently solitary and independent action. Sight and taste and touch and hearing are very different from each other—so separate indeed that the language of the one can hardly be translated into the language of the other. But when from these lower faculties, which are connected with separate and visible organs of the body, and which we possess in common with the brutes, we ascend to the great central group of higher and more spiritual faculties which are peculiar to Man, we soon find that their unity is more absolute, and their interdependence more visibly complete. Ideally we can distinguish them, and we can range them in an ascending order. We can separate between different elements and different processes of thought and in accordance with these distinctions we can assign to each of them a separate faculty of the mind. We think of these separate faculties as being each specially apprehensive of one kind of idea, or specially conducting one kind of operation. Thus the reasoning faculty works out the process of logical sequence, and apprehends one truth as the necessary consequence of another. Thus the faculty of Reflection passes in review the previous apprehensions of the Intellect, or the fleeting suggestions of Memory and of Desire, looks at them in different aspects, and submits them now to the tests of reasoning, and now to the appreciations of the Moral Sense. Thus, again, the supreme faculty of Will determines the subject of investigation, or the direction of thought, or the course of conduct. But although all these faculties may be, and indeed must sometimes be, conceived and regarded as separate, they all more or less involve each other; and in the great hierarchy of powers, the

highest and noblest seem always to be built upon the foundations of those which stand below. Memory is the indispensable servant of them all. Reflection is ever turning the mind inward on itself. The logical faculty is ever rushing to its own conclusions as necessary consequences of the elementary axioms from which it starts, and which are to it the objects of direct and intuitive apprehension. The Moral Sense is ever passing its judgments upon the conduct of others and of ourselves; whilst the Will is ever present to set each and all to their proper work. And the proper work of every faculty is to see some special kind of relation or some special quality in things which other faculties have not been formed to see. But although these qualities in things are in themselves separate and distinct, it does not at all follow that the separate organs of the mind, by which they are severally apprehended, can ever work without each other's help. The sense of logical necessity is clearly different from the sense of moral obligation. But yet as Reason cannot work without the help of Memory, so neither can the Moral Sense work without the help of Reason. And the elements which Reason has to work on in presenting different actions to the judgment of the Moral Sense may be, and often are, of very great variety. It is these elements, many and various in their character, and contributed through the help and concurrence of many different faculties of the mind that men are really distinguishing and dissecting when they think they are analyzing the Moral Sense itself. What they do analyze with more or less success is not the Moral Sense, but the conditions under which that Sense comes to attach its special judgments of approval or of condemnation to particular acts or to particular motives.

And this analysis of the conditions under which the Moral Sense performs its work, although it is not the kind of analysis which it often pretends to be, is nevertheless in the highest degree important, for although the sense of obligation, or, as it is usually called, the Moral Sense, may be in itself simple, elementary, and incapable of reduction, it is quite possible to reach conclusions of the most vital interest concerning its nature and its functions by examining the circumstances which do actually determine its exercise, especially those circumstances which are necessary and universal facts in the experience of mankind.

There is, in the first place, one question respecting the Moral Sense which meets us at the threshold of every inquiry respecting it, and to which a clear and definite answer can be given. This question is—What is the subject-matter of the Moral Sense? or, in other words, what is the kind of thing of which alone it takes any cognizance, and in which alone it recognizes the qualities of right and wrong?

To this fundamental question one answer, and one answer only can be given. The things, and the only things of which the Moral Sense takes cognizance are the actions of men. It can take no cognizance of the actions of machines, nor of the actions of the inanimate forces of Nature, nor of the actions of beasts, except in so far as a few of these may be supposed to possess in a low and elementary degree some of the characteristic powers of Man. Human conduct is the only subject-matter in respect of which the perceptions of the Moral Sense arise. They are perceptions of the mind which have no relation to anything whatever except to the activities of another mind constituted like itself. For, as no moral judgment can be formed, and no moral perception can be felt, except by a moral agent, so neither can it be formed in respect to the conduct of any other agent which has not, or is assumed not to have a nature like our own—moral, rational and free.

And this last condition of freedom, which is an essential one to the very idea of an agency having any moral character, will carry us a long way on toward a farther definition of the subject-matter on which the Moral Sense is exercised. It is as we have seen, human conduct. But it

is not human conduct in its mere outward manifestations, for the only moral element in human conduct is its actuating motive. If any human action is determined not by any motive whatever, but simply by external or physical compulsion, then no moral element is present at all, and no perception of the Moral Sense can arise respecting it. Freedom, therefore, in the sense of exemption from such compulsion, must be assumed as a condition of human action absolutely essential to its possessing any moral character whatever. There can be no moral character in any action, so far as the individual actor is concerned, apart from the meaning and intention of the actor. The very same deed may be good, or, on the contrary devilishly bad, according to the inspiring motive of him who does it. The giving of a cup of cold water to assuage suffering, and the giving it to prolong life in order that greater suffering may be endured, are the same outward deeds, but are exactly opposite in moral character. In like manner, the killing of a man in battle and the killing of a man for robbery or revenge, are the same actions; but the one may be often right, whilst the other must be always wrong, because of the different motives which incite the deed. Illustrations of the same general truth might be given as infinite in variety as the varying circumstances and conditions of human conduct. It is a truth perfectly consistent with the doctrine of an Independent Morality. Every action of a voluntary agent has, and must have, its own moral character, and yet this character may be separate and apart from its relation to the responsibility of the individual man who does it. That is to say, every act must be either permitted, or forbidden, or enjoined, by legitimate authority, although the man who does it may be ignorant of the authority or of its commands. And the same proposition holds good if we look upon the ultimate standard of morality from the Utilitarian point of view. Every act must have its own relation to the future. Every act must be either innocent, or beneficent, or hurtful in its ultimate tendencies and results. Or, if we like to put it in another form, every act must be according to the harmony of Nature or at variance with that harmony, and therefore an element of disorder and disturbance. In all these senses, therefore, we speak, and we are right in speaking of actions as in themselves good or bad, because we so speak of them according to our own knowledge of the relation in which they stand to those great standards of morality, which are fact and not mere assumptions or even mere beliefs. But we are quite able to separate this judgment of the act from the judgment which can justly be applied to the individual agent. As regards him, the act is right or wrong, not according to our knowledge, but according to his own. And this great distinction is universally recognized in the language and (however unconsciously) in the thoughts of men. It is sanctioned, moreover, by Supreme Authority. The most solemn prayer ever uttered upon earth was a prayer for the forgiveness of an act of the most enormous wickedness, and the ground of the petition was specially declared to be that those who committed it "knew not what they did." The same principle which avails to diminish blame, avails also to diminish or extinguish merit. We may justly say of many actions that they are good in themselves, assuming, as we naturally do, that those who do such actions do them under the influence of the appropriate motive. But if this assumption fails in any particular case, we cannot and we do not, credit the actor with the goodness of his deed. If he has done a thing which in itself is good in order to compass an evil end, then, so far as he is concerned, the deed is not good, but bad. It may indeed be worse in moral character than many other kinds of evil deeds, and this just because of the goodness usually attaching to it. For this goodness may very probably involve the double guilt of some special treachery, or some special hypocrisy; and both treachery and hypocrisy are in the highest degree immoral. It is clear that no action, how-

ever apparently benevolent, if done from some selfish or cruel motive, can be a good or a moral action.

It may seem, however, as if the converse of this proposition cannot be laid down as broadly and as decidedly. There are deeds of cruelty in abundance which have been done, ostensibly at least, and sometimes, perhaps, really from motives comparatively good, and yet from which an enlightened Moral Sense can never detach the character of wickedness and wrong. These may seem to be cases in which the motive does not determine the moral character of the action, and in which our Moral Sense persists in condemning the thing done in spite of the motive. But if we examine closely the grounds on which we pass judgment in such cases, we shall not, I think, find them exceptions to the rule or law that the purpose or intention of a free and voluntary agent is the only thing in which any moral goodness can exist, or to which any moral judgment can be applied. In the first place, we may justly think that the actors in such deeds are to a large extent themselves responsible for the failure in knowledge, and for the defective Moral Sense which blinds them to the evil of their conduct, and which leads them to a wrong application of some motive which may in itself be good. And in the second place, we may have a just misgiving as to the singleness and purity of the alleged purpose which is good. We know that the motives of men are so various and so mixed, that they are not always themselves conscious of that motive which really prevails, and we may have often good reasons for our convictions that bad motives unavowed have really determined conduct for which good motives only have been alleged. Thus, in the case of religious persecution, we may be sure that the lust of power and the passion of resentment against those who resist its ungovernable desires, have very often been the impelling motive, where nothing but the love of truth has been acknowledged. And this at least may be said, that in the universal judgment of mankind, actions which they regard as wrong have not the whole of that wrongfulness charged against the doers of them, in proportion as we really believe the agents to have been guided purely and honestly by their own sense of moral obligation.

On the whole, then, we can determine or define with great clearness and precision the field within which the Moral Sense can alone find the possibilities of exercise—and that field is the conduct of men;—by which is meant not their actions only, but the purpose, motive, or intention by which the doing of these actions is determined. This conclusion, resting on the firm ground of observation and experience, is truthfully expressed in the well-known lines of Burns:—

"The heart's aye the part aye
Which makes us right or wrang."

And now it is possible to approach more closely to the great central question of all ethical inquiry:—Are there any motives which all men under all circumstances recognize as good? Are there any other motives which, on the contrary, all men under all circumstances recognize as evil? Are there any fundamental perceptions of the Moral Sense upon which the standard of right and wrong is planted at the first, and round which it gathers to itself, by the help of every faculty through which the mind can work, higher and higher conceptions of the course of duty?

(To be continued.)

PHYSIOLOGICAL EFFECTS OF GLYCERIN.—Chemically pure glycerine if injected under the skin of dogs proves fatal within twenty-four hours if the dose reaches 8 to 10 grms. per kilo. of the weight of the animal. The symptoms are comparable to those of acute alcoholism.—M. M. Beaumetz and Audigé.

ATMOSPHERIC OZONE FOR JANUARY, 1881.

BY L. P. GRATACAP.

The memorable discovery of Ozone by Schönbein, in 1840, bequeathed to the scientific world one of its questiones vexatæ, about which opinions and experiments seem to have been equally at variance. As regards its constitution and essential nature there seems little reason to doubt it is a condensed form of oxygen, according to the views of Andrews and Tait, and that it displays the characteristic properties of that gas in an intensified degree. Its existence in the air can be hardly less questioned, but the extent and origin of its presence are involved in obscurity, and partly from the modifying influence of local circumstances and the identity of its reactions with other atmospheric bodies the conclusions of various experimenters are either equivocal or contradictory. The fact that chlorine, sulphurous fumes, the nitrogen oxides, affect the test papers in the same manner as ozone, and that humidity of the atmosphere, strong winds, bright sunshine, or local nuisances exaggerate or diminish the normal reaction, renders it difficult to eliminate the error introduced by their adventitious influence. The results here given were obtained with test papers of starch and iodide of calcium, prepared, presumably, like those of Dr. Moffat, from starch and iodide of potassium, and compared, after the test, with a scale of colors similar to Negretti and Zambra's.

After E. Schöne's recent condemnation of ozone tests made in this way, they may appear valueless, but it would hardly seem, admitting the justice of Schöne's strictures, that their comparative showing would be seriously impaired. The coloration obtained was in a great measure due to ozone, and its increase or decrease was due in the same proportion to an increase or decrease of this re-agent; the contemporaneous influence of nitrogen oxides may have deepened the tints, it certainly could not have neutralized them, and inasmuch as the papers were kept moist the effects of the varying humidity of the air were, in a measure, cancelled. Precautions against the disturbing influence of winds and that of strong sunshine were also taken. Duplicate observations were taken at 10 feet and at 40 feet from the ground, and their average (though in nearly all cases they proved identical one with the others) recorded, as the color-mark of the hours they were exposed.

Observations were taken every 12 hours, dividing the 24 between day and night, and notes kept of the weather. As a rule, the papers exposed at an elevation were more deeply colored than those near the ground, though this was probably due to a freer circulation of air. The papers at the periods of strongest ozonization were changed throughout; at other times they were marked in spots and near the edges, showing an unequal sensitiveness to the re-agents. In supplementary trials on the effect of the wind, it was found that those papers exposed to the wind were sometimes one-third deeper in tint than the protected ones, and reached their maximum much quicker. These contrasts were, of course, lessened with a diminished velocity of wind.

The manifestations of ozone followed, as a rule, lowered barometric pressure and rising temperature, in other words, they were coincident with change of weather. This is an interesting confirmation of Houzeau's experiments, and in the attempt I make below to give this a graphic demonstration this generalization appears, *i. e.*, that a wave of ozonization follows the storm wave, lagging somewhat behind it, and appreciably corresponding in duration and intensity to the force and continuance of the air wave which preceded it.* In this connection it will be noticed that threatening weather on the 16th and 18th was followed by a sudden projection of the ozone

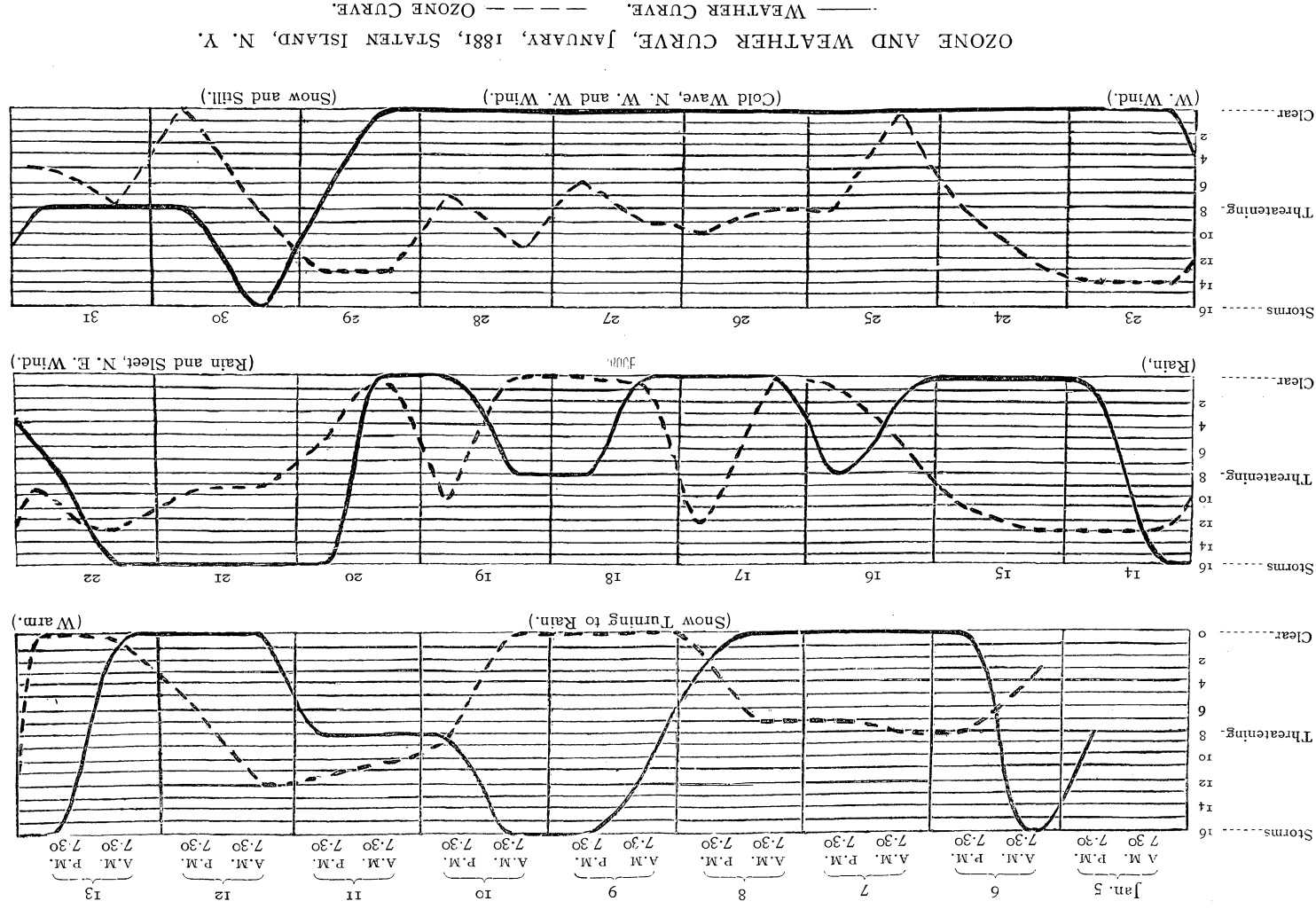
curve which as rapidly subsides, indicating either atmospheric disturbances responsive to an incipient but unfinished change of weather, or else undulations of ozonization coming from some neighboring storm centre or both. Further on the curve of ozonization rises somewhat before that of the weather, and I apprehend this may often or always happen when storms of unusual severity and violence are about to traverse a district. The thrill of ozonization recorded on the papers taken in on the morning of the 20th were prophetic of the fierce and extraordinary tempest which devastated New York and its vicinity upon the 21st.

The high readings from the 25th to 29th accompanied the advent of a cold wave in the Hudson River Valley on the night of the 24th, which sent the mercury down to 15° below 0° at Poughkeepsie and brought colder weather to New York and its vicinity, lasting four days, with strong N.-W. and W. winds. This appears analogous to the strong ozonization concurrent with storms, etc.; the atmospheric disturbance originating the cold wave propagated an ozone wave which appears simultaneously with the former. It is not probably due simply to an apparent increase of normal ozone from the rapid passage of air currents past the tester. This latter effect is doubtless efficient in heightening the entire result, but the wind appears to act as an ozone carrier, bringing into one area supplies of this gas formed in a different and removed one. Indeed it does not appear unwise to speculate upon the possibility of the wind acting as an ozone generator since the irruption of a volume of air at a high velocity of different temperature and density from that of the points over which its path sweeps, must comprise electrical changes, discharges and perturbations. Such effects would correspond in their intensity with the violence and character of the air blast, and we might find the neighboring areas to the track of a cyclone strongly ozonized. As a matter of observation the strong ozonization on the 29th succeeded the strong winds which ushered in the cold of the 27th and 28th. And in any case the deeper tints during wind indicate justly enough the increased prevalence of ozone in the areas swept over by the gale. That wind is not always efficient in changing the ozone papers was shown in Daremberg's experience at Mentone, where, although variations were caused by the wind, in some instances along the sea board the coloration did not at all respond to the strength of the former, and Houzeau is of the opinion that dry winds have slight influence upon the papers.

The cold wave was followed on the 30th by a still snow storm, the shower of pellets falling through an atmosphere unmoved by even a current of air. Threatening weather succeeded the cessation of the snowfall only to usher in the fierce storm of February 1st, when snow, wind, and a low temperature united to arrest life and motion upon the thoroughfares of land and water. The ozone curve responds but feebly to these meteorological perturbations until February 1st, when it slowly rises, recalling Houzeau's conjectures as to storms which generated ozone and storms which did not.

It may seem superfluous, if not trivial, to record any observations upon atmospheric ozone when the whole subject is involved in a fog of scientific confusion, contempt and obloquy. It may be said that these observations presented no inconsistent, aberrant or contradictory results, and that to the general student of our local meteorology they may in this graphic form exhibit some features of interest. The chart is simply suggestive and absolutely artificial; the numbers on the left of the lines indicate degrees of coloration and the weather line is determined by three points: clear, threatening and stormy. The readings were made at West Brighton, Staten Island, in New York Harbor, the maxima of colorations, and hence ozone, considered as coincident with the time at which the reading was taken, 7.30, night and morning, which must be at times barely approximative.

* As regards the sensible effects of the ozone following by many hours the opening of the storm on the 9th and 13th, the reactions appeared concurrently with a change in the weather from snow to rain. On the other hand, the storm of the 21st opened with rain.



NOTE ON THE "POSTERIOR BRAIN" OF STEGOSAURUS.

In a paper before the National Academy of Sciences in November last, and more recently in an illustrated article in the *American Journal of Science*, February, 1881, Professor O. C. Marsh has described certain remarkable peculiarities of *Stegosaurus ungulatus*, one of the Dinosaurian Reptiles of the American Jurassic formation.

Judging from the figures, which are said to be reduced to one-sixteenth of the natural size, the arm of this species must have been about one meter in length, while the leg was about twice as long. "The great disproportion in size between the fore and hind limbs, as well as the structure of the principal joints in each, show plainly that *Stegosaurus* walked mainly as a biped. The massive posterior limbs, and the huge tail doubtless formed a tripod on which the animal rested at times, while the fore limbs were used for prehension or defense. The heavy dermal plates and powerful spines probably rendered the latter an easy task."

After recalling the statement which had been made by him in a previous article, that, proportionately, "this reptile had the smallest brain of any known land vertebrate," Professor Marsh describes with some detail "a very large chamber in the sacrum, formed by an enlargement of the spinal canal. This chamber was ovate in form, and strongly resembled the brain case in the skull, although very much larger, being at least ten times its size. . . . A perceptible swelling in the spinal cord of various recent animals has been observed in the pectoral and pelvic regions, where the nerves are given off for the anterior and posterior limbs; and in extinct forms some very noticeable cases are recorded, especially in Dinosaurs. . . . In some allied forms, *Camptonotus* for example, where the disproportion between the fore and hind limbs is nearly as marked, the sacral enlargement of the spinal cord is not one-fourth as great as in *Stegosaurus*. It is an interesting fact that in young individuals of *Stegosaurus* the sacral cavity is proportionately larger than in adults, which corresponds to a well-known law of brain growth. The physiological effects of a posterior nervous centre, so many times larger than the brain itself is a suggestive subject, which need not be here discussed. It is evident, however, that in an animal so endowed, the posterior part was dominant."

In the hope that Professor Marsh may continue his important observations and reflections upon this subject, attention is called to the following points:

1. It seems to be taken for granted that "the posterior nervous centre" was as large as the sacral cavity. This is hardly warranted, although it is certainly favored by the size of the sacral foramina. The cranial part of the elephant's skull is far larger than is required for the lodgment of its brain, on account of the surface needed for the attachment of the immense cervical muscles. With many fishes, especially some skates and the *Lophius*, the brain occupies but a small part of the capacious cranial cavity. May it not be, then, that the sacral cavity of *Stegosaurus* was enlarged, in part at least, in correlation with a general enlargement of the whole pelvis, in reference to the functions of the legs?

2. Unless such examinations have been made already, it would be well to ascertain the condition of the myelon in the kangaroos, and that of the sacral cavity in *Diprotodon* and *Megatherium*, all of which may be compared with *Stegosaurus* in respect to the size of the legs, or their employment in connection with a large tail.

It would be interesting to know the form and size of the entire myelonal canal of *Stegosaurus*. The paper leaves us in doubt as to whether the writer considers the "posterior nervous centre" as the homologue of the ordinary "lumbar enlargement" of the myelon in man and other vertebrates. If not, may it be the not yet

wholly abbreviated representative of what the late Prof. Jeffries Wyman referred to in his paper "On Symmetry and Homology in Limbs"? In some adult fishes the spinal marrow ends in a ganglionic enlargement forming a kind of caudal brain. We have found such a ganglion quite conspicuous in the American *Lophius*. In either case, it is probable that the remarkable condition of things in *Stegosaurus*, as described by Prof. Marsh, would have appeared to Prof. Wyman as an example of the law of organic polarity in the form of "fore-and-hind symmetry," which has been advocated by him, by Dr. Coues, and by the writer of the present notice.

B. G. W.

THE ROMANCE OF ASTRONOMY.—Those interested in astronomy will be pleased to know that Professor R. Kalley Miller's delightful work "The Romance of Astronomy," has been published by the "Humbolt Library." Professor Miller is a professor at Cambridge, England, and has received aid from his distinguished colleagues, Sir William Thomson and Professor Tait. An appendix by Mr. R. A. Proctor is added. We remind our readers that the above work can be purchased for 15 cents, and that under the advantages now offered by club rates (to subscribers only), the 24 numbers issued annually can be secured for \$2.25—an average of about 9 cen's each.

ATMOSPHERIC DUST.

At the period of the great debate on spontaneous generation between M. Pasteur and Pouchet, the latter was the first to draw attention to the fact, that some of the minute spherical granulations, discovered by the microscope in dust deposited from the air in various regions of the globe, were essentially composed of silica. That they had often been mistaken for eggs of infusoria or for micrococci was very evident; but when the dust was submitted to complete calcination in a platinum crucible the same grains were still visible, with the same forms and dimensions as before.

I have more than once repeated this experiment of Pouchet's, but I have also made the opposite one and examined the action of heat upon micrococci, diatoms and oscillariæ, which are supposed to contain large quantities of silica.

There is no doubt that the dust of the atmosphere reveals to the microscope, besides the larger mineral fragments mostly of an angular shape, exceedingly minute circular or spherical bodies, being often not more than 0.001 of a millimetre in diameter, and very similar in size and shape, which resist the action of a white heat in contact with the air, and that of strong hydrochloric acid. In some of my observations they were remarkably numerous. Both before and after the action of heat they are more or less transparent. What can be the origin of these singular objects?

The same experiments repeated with siliceous algæ, such as those belonging to the large family of the *diatomacæ*, and with the *micrococci* of impure waters or vegetable infusions, showed me that they do not retain their forms after being subjected to the above treatment, and that in many instances they can be totally destroyed by heat on the object glass itself. On the other hand, the fossil diatoms resisted the action of heat and acids and retained their forms. I can draw only one conclusion from these observations: namely, that the minute siliceous bodies found in the atmosphere are also fossil—they are micrococci of another age.—Dr. T. L. PHIPSON, F.C.S.

SILVER BROMIDE.—The action of light upon this substance varies according as the bromide is in the state of emulsion in an indifferent medium, like collodian, or in an organic substance readily oxidisable, like gelatine. Temperature, moisture, and mechanical pressure do not appear to have any influence.

ASTRONOMICAL MEMORANDA.

THE CORDOBA OBSERVATORY.

In the fall of 1870, Dr. B. A. Gould, formerly director of the Dudley Observatory, Albany, arrived in Cordoba, for the purpose of establishing a National Argentine Observatory, and making the requisite observations for forming a complete catalogue of the principal fixed stars of the southern hemisphere. A long delay of about two years, in the receipt of the instrument necessary to make these observations, has been the cause of giving to the world the *Uranometria Argentina*, a work analogous to the *Uranometry* of Argelander, which rendered such signal service to astronomy more than forty years ago.

Cordoba is situated about five hundred miles northwest of Buenos Ayres, the Observatory occupying a height upon the outskirts of the town, in latitude $31^{\circ} 25' 15.4''$ south; longitude $0^{\text{h}}, 51^{\text{m}}, 27^{\text{s}}$, east from Washington. The equipment of the Observatory consists of a 12.5 inch equatorial (object glass by Fitz) used mainly for observing comets, etc.; a smaller equatorial of about 8 inches aperture, devoted to observations of variable stars; a Zöllner photometer; and various accessory instruments. But the most important instrument is a Repsold's Meridian Circle of about 8 inches aperture, which was mounted and ready for use in September, 1872. With this instrument observations of zones from 23° south, to 80° south declination—760 zones embracing 106,000 observations—have been completed, and the reductions have been well advanced. To determine absolute positions of all stars included in this catalogue, the instrumental constants were determined before and after each zone by a series of observations "consisting of transits of two standard time stars, as well as of one circumpolar star above, and one below the pole, together with measurements of nadir, collimation and level."

Dr. Gould has established, though necessarily on a limited scale, a Signal Service which will doubtless develop rapidly, when meteorology receives more attention in South America than it does at present. Meanwhile data of inestimable value are being collected at very slight expense, by interesting many of the intelligent land owners, in making such observations of the barometer, thermometer, etc., as may be made with little outlay of time and trouble. A Time Signal is sent at noon once a week, over the available telegraph lines of the country.

A force of four observers and several copyists, mostly Americans, is engaged upon the work in the various departments, and Dr. Gould has taken with him, within the past few months, a photographer, in order to obtain exact representations of several very interesting star clusters, which can be compared directly with the appearance of the cluster at any future time, and thus afford a means of detecting any changes which may occur in the relative positions of the component stars.

It is to be hoped that the political party now in power, —under whose auspices these institutions have originated and have been maintained—will retain its influence in the government, and thus be enabled to promote the interests of science in the country.

DISCOVERY OF A NEW ASTEROID.

The Smithsonian Institution has received from Professor Foerster, of Berlin, the announcement of the discovery, by Palisa, of a planet of the tenth magnitude, in eleven hours thirty-nine minutes Right Ascension, eight degrees twenty-five minutes north declination, with a daily motion of one minute, north. This discovery brings the total number of asteroids up to two hundred and twenty, making the eighth discovered since February 6, 1880. The date of discovery is omitted.

In a paper recently read before the Royal Astronomical Society, Mr. Stone has called attention to "some difficulties connected with the determination of the diameter of Mars." Upon examining the Greenwich observations of the diameter, since 1851, very marked personal equations have been noticed in the different observers, discrepancies which seem somewhat difficult to account for. Mr. Stone says, "it looks as if there were two different diameters of Mars observed,—one when Mars is comparatively near to us, and the other when it is at its greatest distance from us. The result is that as far as one can trace it, there is a distinct break of continuity between the smaller and the larger measures; as if the observers had included the planet's atmosphere when Mars is distant."

SWEDEN has decided to take part in the international meteorological and magnetic observations in the Polar regions, and will establish two observatories, one at Masselbay in Spitzbergen, and one at Haparanda at the head of the Gulf of Bothnia. Haparanda is to be well supplied with self-registering and printing meteorological apparatus, and with astronomical instruments to carry on a series of regular observations.

PROFESSOR PICKERING has called attention to the peculiar resemblance between the spectrum of the star Oeltzen 17681 and that of the three stars discovered by Wolf and Rayet in 1867, (*Comptes Rendus*, vol. lxx., p. 292). The relative brightness is found to be different in these spectra, and the subject promises to repay further investigation.

Washington, D. C., March 3, 1881.

W.C.W.

THE DAVIDSON ASTRONOMICAL OBSERVATORY AT SAN FRANCISCO, CALIFORNIA.

Prof. George Davidson, of the United States Coast and Geodetic Survey, has established a private observatory in San Francisco, and mounted the six-and-a-half inch Equatorial which was exhibited at the Centennial, but which has now a Villarcean governor, spectroscope, and other improvements.

The geographical position of this observatory is:

Latitude = $37^{\circ} 47' 22.3''$ north.

Longitude = $122^{\circ} 24' 39.0''$ west of Greenwich.

In time = $8^{\text{h}} 09^{\text{m}} 35.60^{\text{s}}$ west of Greenwich.

This fixes it as the most western observatory in America.

To observe the total solar eclipse of January 11, 1880, Prof. Davidson transported the instrument and the observatory to the summit of Santa Lucia Mountain, about thirty-five miles southward of Monterey, and six thousand feet elevation above the Pacific ocean. In this undertaking everything had to be carried up four thousand feet over a very steep and rugged trail by pack mules; and the party encountered one of the fiercest snow storms of that coast, but successfully accomplished the object of the undertaking which was made under the directions of the Superintendent of the Coast Survey. Whenever opportunities offer for observing at not less than ten thousand feet elevation, he will transport it to these high stations. [It was intended to use it in 1879 at two of the coast survey stations occupied in the Sierra Nevada having elevations of 9800 to 10,600 feet, but unfortunately it was not received in season.]

Mr. Davidson has been engaged in regular coast survey duties upon the Pacific almost continuously since the Spring of 1850, and has had large experience in observing at great elevations.

AN international exhibition connected with electricity will open in Paris, August 1, 1881, and will close on the 15th of November following.

SCIENCE IN FRANCE.

PARIS, February 12, 1881.

There is so much at present which is both novel and important in the scientific world, that I fear, in my endeavors to do full justice to everything, I shall, by attempting too much, find myself in a position analogous with that of a certain unfortunate person mentioned in history, who, while striving to seat himself upon two chairs simultaneously, fell ignominiously to the ground.

But let us not waste time in odious comparisons! The news has probably long since reached you of a wonderful fossil forest which has recently been discovered in Hindoostan, and of a prehistoric grotto somewhere on the border line of France, containing various kinds of warlike weapons of an exceedingly primitive design, together with a single human tooth. It is not of these, however, that I intend to speak, as beyond the facts themselves nothing of particular interest remains to be told.

In the medical world a little instrument newly invented, is attracting considerable attention. It is called the *crayon feu* and is worthy of something more than a passing description.

That all intelligent physicians recommend instant cauterization when a person has been bitten by a mad dog, or indeed a dog of any sort, is a well-known fact. It is not, however, generally speaking, an easy matter to find an appropriate piece of iron and a lighted fire all ready for the operation, and consequently it usually happens that some time elapses before the remedy can be applied. Of course we all know that delay in such matters frequently proves fatal, and it was of this undoubtedly that Dr. Moser was thinking when he invented the tiny, portable apparatus which he calls the *crayon feu*, and which is so simply constructed that it can be used alike by physicians, travellers, hunters, or indeed any one who has either been bitten himself or who is required to treat another person.

This little instrument consists of a pencil made of some peculiar composition which ignites instantly when a match is applied to it and becomes red-hot while the patient's wound is being washed. The point of the pencil is then introduced directly into the wound, and the cauterization is performed in an instant. The patient merely experiences a slight sensation of being burned, as the operation is over before he is able to feel any definite pain. A little wooden or metal cover is placed over the pencil when it is not in use, and at the other end is a small receptacle for the particular kind of wax matches which are required to light it.

The *crayon feu* is indeed *multum in parvo* and can be carried in the vest pocket. Medical men, scientific societies, and all public administrations in Paris have given it a warm welcome—no pun is here intended—and their example has been followed by a host of others, while Dr. Moser himself, is looked upon as a veritable benefactor to humanity.

No less interesting are the curious experiments recently made by a Hungarian, M. Kerdig, by means of a combustible substance which is undoubtedly destined to be used at some future time for illuminating purposes.

M. Kerdig begins by placing upon a table a number of lamps filled with this fluid, which, indeed, gives forth a most brilliant light. He then announces to the interested spectators that it is in no danger whatever of catching fire or exploding, and in order to illustrate this fact so that even the veriest skeptic shall believe, he pours a quantity of the liquid upon his hat and calmly sets fire to it. A mass of lurid flame rises instantly almost to the ceiling, but M. Kerdig, in no wise disconcerted, places his hat coolly upon his head, and waits until the flame gradually dies out. He then exhibits the hat triumphantly to the audience—it is uninjured. He next sets fire to the floor, then to his handkerchief, saturated with the sub-

stance, and finally goes so far as to pour some of it into the palm of his hand and light it; but the floor, the handkerchief and the hand are all alike unharmed.

Of course all this appears most extraordinary at first sight, but a little careful investigation is in this case, as in many others, capable of reducing mountains to mole hills. The vapor of M. Kerdig's mineral substance possesses considerable expansive force, so that in reality it is the vapor which burns and not the liquid. The latter being at a very low temperature, produces no sensation of heat upon the hand, notwithstanding the flame above.

Now, I suppose you would like to know of what this interesting product consists. M. Kerdig says that it is a very volatile essence of naphtha, to which is added a compound of various evaporating substances. Other people, however, affirm that it is a product derived from natural oils recently discovered in Hungary, which, when properly distilled, results in a peculiar substance, very volatile, and, what is of still more importance, very cheap. A faint odor of petroleum pervades it, accompanied by a slight aromatic fragrance, and when spread upon the hand a sensation of cold is felt.

We have just received intelligence from the south of France of the terrible ravages made upon the olive crops this season by an insect designated by the entomologists as the *Dacus oleæ*. It is a little gray fly, with several legs, and long yellow antennæ. There are two generations of them every year, one appearing in July, the other in September. The eggs are deposited in the fruit, and the larva, which resembles a little yellowish-white maggot, consumes the pulp, intersecting it with tiny passages. The adult leaves the olive and makes its way to the ground, where it is transformed into a chrysalis and remains buried during the winter months.

Speaking upon agricultural topics reminds me of an unprecedented phenomenon which has just occurred in one of the districts of Jonzac. Upon the estate of a certain M. Delaume, who lives at Sèville, there is a grape vine which for five years has been infested with phylloxera, and the greater part of whose branches have borne nothing whatever—neither leaves nor fruit during that period. But a most unforeseen and extraordinary thing suddenly happened. From one branch, which has hitherto been looked upon as quite dead, has sprung a magnificent grape vine, well formed, and of a beautiful, dark green color. No one, as yet, has been able to explain this singular occurrence.

Still less can we account for another most remarkable event, a description of which I lately read in a Hungarian paper. A criminal, it seems, had been hanged, and the physician in attendance declared that life was quite extinct. An autopsy was subsequently made upon the body, and the latter subjected to the action of a strong galvanic current. Within the space of two hours, signs of life were distinctly observed. The dead man recovered his senses completely, but succumbed, on the second day following, to cerebral congestion.

If this account be true, we cannot too greatly encourage the use of electricity as a resuscitative and vital agent, nor can we fail to admit that the present age is one of unparalleled phenomena. COSMOS.

LAWS OF THE DISENGAGEMENT OF ELECTRICITY BY PRESSURE IN TOURMALINE.—The authors announce the following laws as resulting from their experiments:—The two ends of a tourmaline evolve quantities of electricity respectively equal, but of opposite signs. The quantity liberated by a certain increase of pressure is opposite in its sign, but equal to that produced by an equal decrease of pressure. This quantity is proportional to the variation of the pressure, independent of the length of the tourmaline, and for one and the same variation of pressure per unit of surface it is proportional to the surface.—M. M. Jacques and Pierre Curie.



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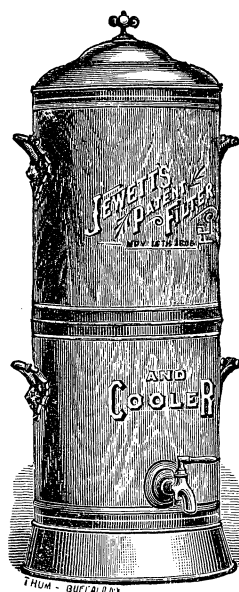
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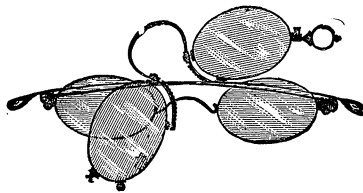
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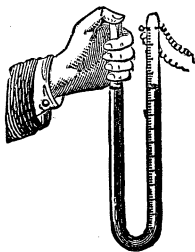
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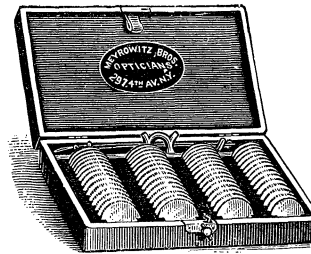


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